Problem Solving

Construct Progression

DOMAIN: Cognitive Development

CLAIM: Students can use content-independent abilities and strategies as well as content-specific skills, processes, and approaches to solve problems and acquire information.

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Background Information

The purpose of this construct progression is to determine children's skill level when engaged in the cognitive problem solving process. The focus of this progression is HOW children problem solve. This progression is NOT about whether or not children successfully solve problems. This progression describes the development of academic/cognitive problem solving. This progression is NOT about how children solve social problems or how they handle their feelings, relate to others, or persevere in challenging activities.

Problem solving skills are also typically reflected in state Early Learning and Development Standards (ELDS) as well as K – 3 standards. An analysis of the ELDS in the 10 Consortium states (Scott-Little, Reid, Kagan, et al. 2014) reflected multiple aspects of problem solving in most states: recognizing and solving problems, trial and error/multiple solutions, and describing and explaining solutions. For example, North Carolina's Foundations for Early Learning and Development includes relevant standards in approaches to learning and cognitive development:

- Goal APL-6: Children use a variety of strategies to solve problems.
- Goal CD-2: Children recall information and use it for new situations and problems.

And the Common Core State Standards in mathematics reflects the following problem solving skills:

- Make sense of problems and persevere solving them.
- Reason abstractly and quantitatively.
- Construct viable arguments and critique the reasoning of others.

Rationale

In Assessment for Learning and Development in K-3, (the NC Think Tank report), the rationale for the claims within the Cognitive Development domain states, "Children's cognitive capabilities provide the foundation for learning that occurs in school and in life. These cognitive skills - including regulating attention, remembering, reasoning, and problem solving - enable children to understand new information and apply it to new situations. Research indicates that strong cognitive skills positively affect educational outcomes (Raver, 2012; Evans & Rosenbaum, 2008; Duckworth & Seligman, 2005). Moreover, the continuing development of cognitive skills, as necessary for ongoing mastery, depends upon active engagement in developmentally appropriate education."

The understandings, skills, and performance descriptors in this construct progression describe the development of academic problem solving in young children. This progression is not developmentally inevitable but rather reflects the problem solving capabilities that children progressively develop as a result of experience and instruction. In order for children to practice problem solving, teachers need to provide an environment that allows for discovery learning and opportunities to solve problems.

According to Ginsburg (2015), problem solving is an activity that requires interpretation, sense making, the acquisition and application of strategies, and the articulation of the deep thinking behind the figuring-out that occurs. Ginsburg proposes that even though students will vary in their ability to justify and explain their problem solving process, sophisticated problem solvers not only solve problems but also justify why their solution makes sense.

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Children understand that there are academic problems and they can attempt to solve them.	A. Acknowledges that a problem exists without attempting to solve it (this may manifest as a child moving away from the problem).	After encountering a problem, child does not attempt to solve the problem. For example, child: 1. Does not do anything related to the problem. 2. Says, "This is too hard," and does not attempt to solve the problem. 3. Leaves the table. 4. Works on something else. 5. Talks or writes about the problem. without identifying a potential approach to solving it.	*Ms. Osses begins each day by posting a "Challenge Problem of the Day" for children to solve. Today's problem is "Look at the number 956. Show me how you would represent this using base ten blocks." Ben goes up to the board, points to each number, and reads it aloud, "Nine, five, and six." He watches other children working with the base ten blocks for a moment and then leaves the table.*
	B. Attempts to solve a problem by mimicking the motions and procedures of others OR seeking general support from others very early in the problem solving process (e.g., how do I do this? I don't know what to do.).	After encountering a problem, child does one of the following: 1. Mimics what another child is doing OR 2. 2. Asks for help from an adult or peer (e.g., "how do I do this?"; "I don't know what to do") Note: If a child mimics the approach of another child OR asks for help, the observation should be noted as Skill B regardless of whether or not the problem was solved or more advanced problem-solving skills were demonstrated. If a child demonstrates a higher skill AFTER mimicking another child or asking for help, an additional observation would be necessary to confirm the higher level.	*Jim sees Pragnya making stacks with her base ten blocks and mimics this behavior, but he does not understand her approach. Jim stacks the blocks randomly and is unable to represent 956.* *Kathryn wants to put together a wooden puzzle. After trying to put two pieces together, she asks Su, "How do you get the pieces to fit?"*
	C. Attempts to solve a problem using random trial and error.	Child haphazardly tries to solve the problem without any evidence of a thought-out approach.	*Myer is working on a poster for Earth Day that supports the theme "Earth Day, Every Day!" Myer cuts out random magazine pictures that are off-topic.*

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		NOTE: The difference between Skill C and Skill D (using familiar procedures), is that using familiar procedures involves applying logic.	*When Mrs. Caldwell asks Myer how his poster supports the theme, he says, "I don't know. I was just cutting out pictures that I liked."*
Children understand that in order to solve problems, they can use familiar procedures.	D. Solves OR attempts to solve a familiar problem using procedures learned in previous problem solving experiences.	Child applies a previously learned procedure while trying to solve a familiar type of problem.	*While putting together a wooden puzzle with the same number of pieces as puzzles he has solved before, George remembers to place the corners first and work next on the flat-sided border pieces. George is unable to complete the puzzle because this procedure doesn't work for the remaining pieces.*
	E. Solves OR attempts to solve a novel problem using procedures learned in previous problem solving experiences without demonstrating knowledge of why the procedure is or is not successful.	Child applies a previously learned procedure while trying to solve a new type of problem but does not understand why the procedure worked or did not work.	*Mrs. Caldwell's class has been learning about how laws are passed at the local government level. She challenges her students to write a "law" that they would like to have at school. Jonathan writes about being able to sit where you want to in the cafeteria. He looks at the "Writing About Our Opinions" chart on the wall, includes an opinion statement, and provides reasons to support his opinion. Jonathan reads his writing aloud, and the class cheers and starts saying things like, "Yeah, we need that law!" Mrs. Caldwell asks Jonathan if he knows why his writing worked so well and has the students excited, and he says, "I don't know. I just wrote what I was thinking."*
Children understand that in order to solve problems, they can use concepts, in addition to procedures.	F. States a hypothesis about how to solve a novel problem, using both concepts and procedures.	Child communicates his/her own potential approach for solving a new type of problem. The potential approach connects conceptual and procedural knowledge. The child does not have to implement the approach.	*Ashley sits down next to Thomas as he tries to solve a flash card problem. She says, "Hey, these numbers are just like the numbers in today's Challenge Problem! I think if we make 186 and 30 with unit blocks and then count all the blocks, we can trade for bigger units and get the answer."*
	G. Solves OR attempts to solve a novel problem by connecting concepts and using familiar	Child applies conceptual and procedural knowledge while trying to solve a new type of problem. The child must implement the	*Dawson takes out a new 3D puzzle of a globe. He dumps out all the pieces, turns them right side up, and looks through the pieces for a minute. Then Dawson*

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	procedures.	approach.	*says, "Hey, there's no edge pieces." He looks more closely at the picture on the box and says, "Oh, it's a ball-shaped puzzle." He starts putting the pieces together, intermittently looking at the box for guidance. When Mr. Pellichero asks Dawson to tell him about his plan for solving the puzzle, Dawson says, "I'm using the picture on the box to know where the pieces go; just like I do with other puzzles. I also remember what we learned in class and that helps. Like I remember we learned about Africa and that it is below Europe on the map so that helps me know where to put the pieces that say "Africa."*
Children understand that concepts and procedures are used to solve familiar and novel problems efficiently.	H. Generates AND explains an alternate problem solving approach (including when an approach is not working).	Child communicates his/her own alternate approach for solving a problem AND explains the approach. NOTE: Child may not explain the alternate approach spontaneously. The teacher may probe for an explanation.	*Joe wants to put together a 3-D stegosaurus. He knows that the backbone of a stegosaurus goes from small pieces at the neck, to larger pieces on the back, to smaller pieces at the tail. When he attempts to build a stegosaurus with unit blocks, the blocks will not support each other from small to large to small. So, Joe tries building with plastic interlocking blocks and is successful. Joe explains that the unit blocks won't work because of the weight of the larger ones, but that plastic interlocking blocks work because locking together gives them stability.*
	I. Generates AND explains multiple approaches for solving a problem.	Child communicates his/her own multiple approaches for solving a problem AND explains some of the approaches. NOTE: Child may not explain the approaches spontaneously. The teacher may probe for an explanation.	*While Beckett and Joe are discussing ideas for a making a book on airplanes, Mrs. Caldwell overhears Beckett say, "Let's make a flip book or we can use that stop motion app that we used in class last week. Both would show airplanes moving."*
	J. Provides justification for why a chosen self- or peer-generated problem solving approach	Child identifies the approach he/she believes is the most efficient for solving a problem and justifies why he/she thinks the	*During a math lesson involving 2-digit + 2-digit problems, Ms. Gonzalez asks the class if anyone can explain how they solved the problem 26 + 15. Rea says,*

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	might be the most efficient one for solving a problem.	approach is the most efficient as compared to another approach.	*"I grouped by tens. 5 + 5 is 10; 10+10+20 is 40; +1 is 41." Ms. Gonzalez asks Rea to explain why she thinks that was the best way to solve the problem. Rea says, "It was quicker than counting on from 26 and faster than drawing 26 dots and 15 dots and counting them all."*

RESOURCES

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